Draft Rainfall Atlas 14: Replacement of Technical Paper 40

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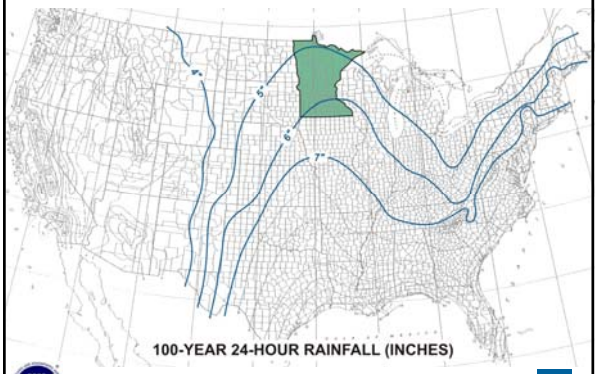
agenda

- TP-40 background
- Atlas 14 development
- Atlas 14 results
- TP-40/Atlas 14 comparisons
- Atlas 14 peer review
- Atlas 14 implications
- questions/discussion

Technical Paper 40 (TP-40)

- key document for hydrologists and water planners
- gives rainfall data for every county in every state
  - **rainfall frequency or recurrence intervals:** 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year events
  - **rainfall durations:** 30-minute, 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 24-hour, 2-day, and 4-day events

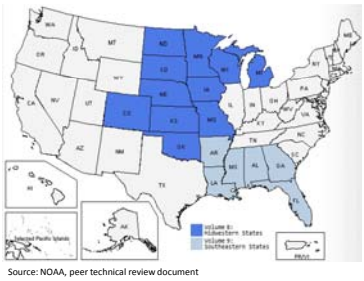


Technical Paper 40 (TP-40)

- prepared by NOAA for U.S. Department of Commerce
- initial publication in 1961
- universally used and widely accepted
- developed using available rainfall information from far fewer stations than exist today
- included the “dust-bowl” years of the 1930’s
- questions about under-projecting rainfall depths given recent storms

Atlas 14 (the new TP-40)

11 states (dark blue) pooled funds to update



Source: NOAA, peer technical review document

Atlas 14 timeline

- Dec 2005: NOAA presentation to various agencies and organizations
- Nov 2007: NOAA webinar to rally state support
- mid-2009: project begins with target completion by Dec 2012
  - adding additional states (WI, MI, CO, OK) delays project
- fall 2012: peer review
- spring 2013: web publication

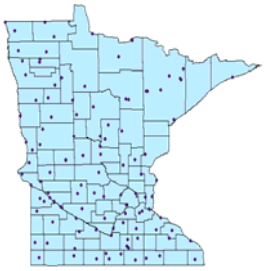
funding, support and data suppliers for Minnesota's component of the study

- funding
  - Minnesota Department of Transportation State Aid
  - Minnesota Pollution Control Agency
  - Legislative-Citizen Commission on Minnesota Resources
- letters of support
  - City Engineer's Association of Minnesota
  - American Public Works Association: Minnesota Chapter
  - Minnesota Stormwater Steering Committee
- data suppliers
  - Minnesota Department of Transportation State Aid
  - Minnesota Pollution Control Agency
  - Minnesota State Climatology Office
- and many others

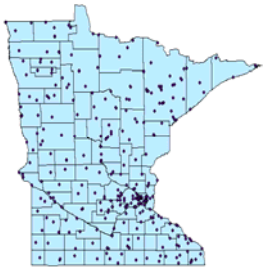
Minnesota data facts

- 1,089 locations with data
- 405 data sets used in the analysis
  - 320 daily observation stations vs. 110 in TP-40
  - 86 sub-daily observation stations vs. 30 in TP-40
- reasons a data set not used:
  - too few years, duplicate, sampling issues, annual maximum series quality concerns, no metadata

TP-40 Minnesota daily stations



Atlas 14 Minnesota daily stations



improved science

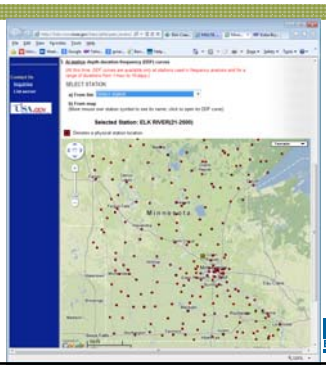
- average record length now over 50 years
  - more than double the record used in original studies
  - oldest Minnesota data set from 1836 (Ft. Snelling / Minneapolis St. Paul Airport)

improved science

- new statistical approaches
  - less sensitive to outliers
  - regional approach pools information and reduces uncertainty
  - uncertainty estimates can be derived
- spatial interpolation
  - accounts for high resolution spatial variation of climate and terrain
  - product now gridded on 30 arc-second scale (~1 km)
  - downloadable GIS formats

improved usability

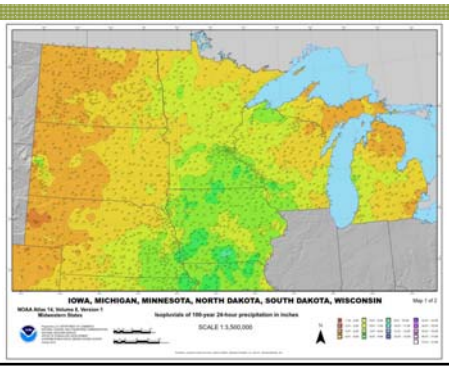
- interactive web interface
  - click to a specific points: no more estimating



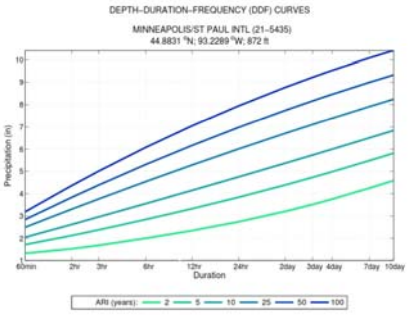
peer review of Atlas 14 technical results

- the following information was available for review:
  - cartographic maps
  - at-station depth-duration-frequency (DDF) curves

Atlas 14: 100-year, 24-hour event



Atlas 14: Depth/Duration/Frequency Curves



TP-40/Atlas 14 comparisons for Minnesota, South Dakota, North Dakota, and Wisconsin

- some significant increases in each state
  - most of Minnesota and Wisconsin, eastern North Dakota, and the Black Hills of South Dakota
  - percent change in 24 hour/ 100 year depths:
    - Minneapolis, MN - 6.0 to 7.9 inches (+32%)
    - Ashland, WI - 5.3 to 7.3 inches (+38%)
    - Fargo, ND - 5.3 to 6.3 inches (+19%)
    - Rapid City, SD - 4.6 to 5.7 inches (+24%)

Atlas 14 variation in Minnesota, South Dakota, North Dakota, and Wisconsin

- some surprises (large changes over short distances)
  - difference in 24 hour/ 100 year depths (inches):
    - Minneapolis, MN to St. Cloud, MN: 7.9 to 6.1 (1.8" dif)
    - Worthington, MN to Sioux Falls, SD: 7.8 to 5.9 (1.9" dif)
    - McLeod, ND to Big Stone City, SD: 6.4 to 5.7 (0.7" dif)
    - Duluth Airport, MN to Superior, WI: 6.7 to 6.1 (0.6" dif)

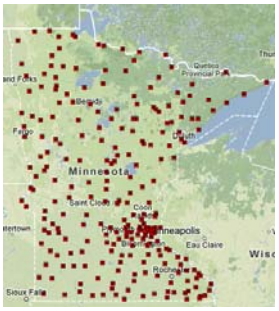
TP-40/Atlas 14 comparisons for Minnesota, South Dakota, North Dakota, and Wisconsin

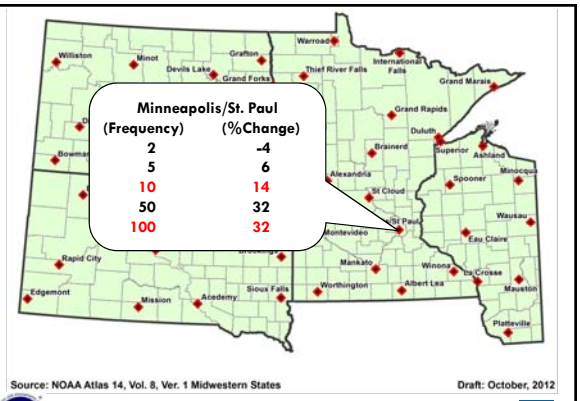
- some decreases for certain storms
  - central Minnesota, western North Dakota, most of South Dakota, and eastern Wisconsin
- degree of change increases as storm frequency decreases
  - example:

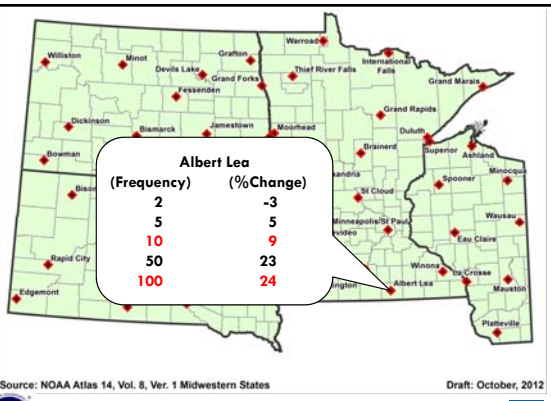
Minneapolis/St Paul	
Frequency	% Change
2	-4
5	6
10	14
50	32
100	32

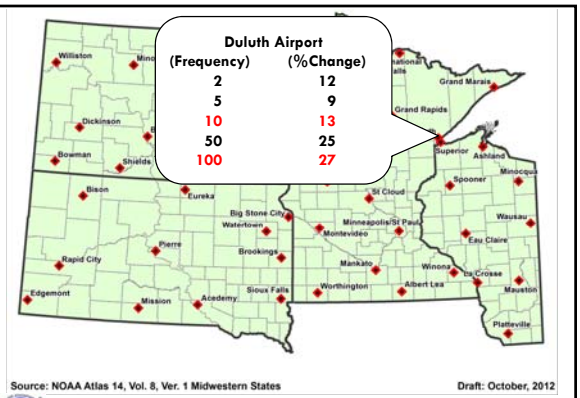
Atlas 14 station locations: Minnesota

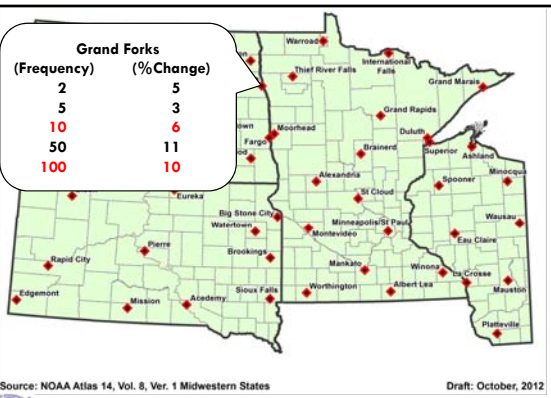
http://hdsc.nws.noaa.gov/hdsc/pfds/peer_review/peer_mn.html

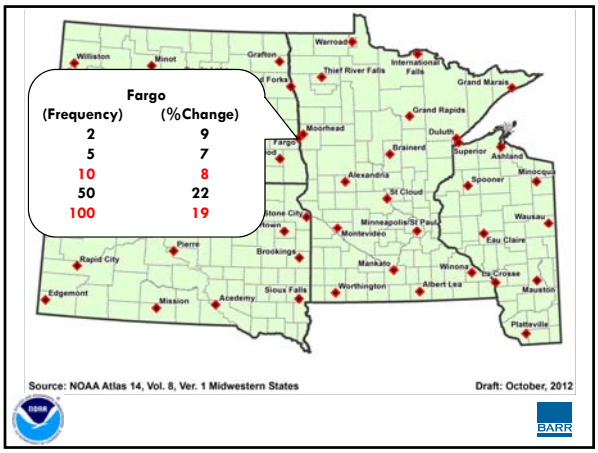











Fargo
(Frequency) (%Change)
2 9
5 7
10 8
50 22
100 19
Source: NOAA Atlas 14, Vol. 8, Ver. 1 Midwestern States
Draft: October, 2012
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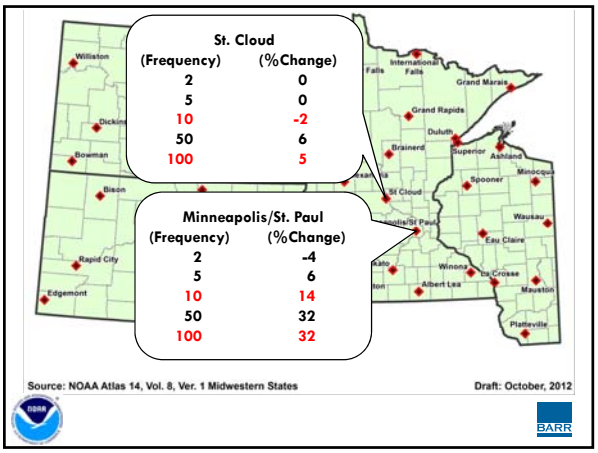
St. Cloud
(Frequency) (%Change)
2 0
5 0
10 -2
50 6
100 5
Minneapolis/St. Paul
(Frequency) (%Change)
2 -4
5 6
10 14
50 32
100 32
Source: NOAA Atlas 14, Vol. 8, Ver. 1 Midwestern States
Draft: October, 2012
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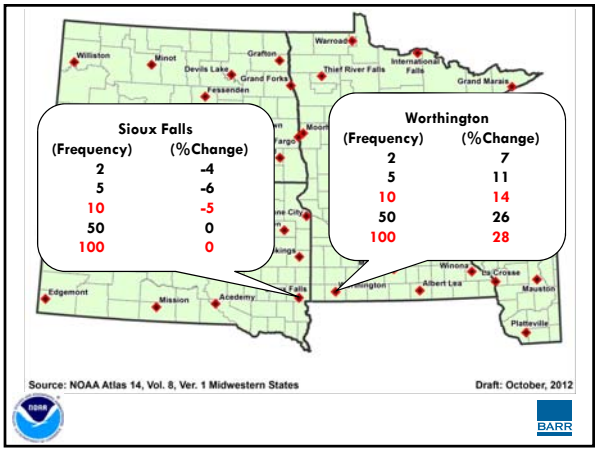
Sioux Falls
(Frequency) (%Change)
2 -4
5 -6
10 -5
50 0
100 0
Worthington
(Frequency) (%Change)
2 7
5 11
10 14
50 26
100 28
Source: NOAA Atlas 14, Vol. 8, Ver. 1 Midwestern States
Draft: October, 2012
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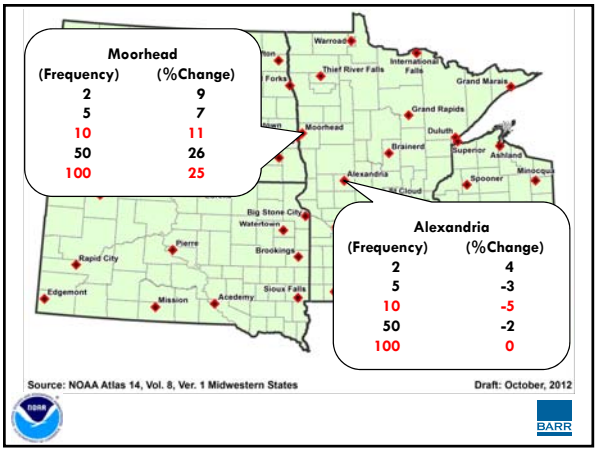
Moorhead
(Frequency) (%Change)
2 9
5 7
10 11
50 26
100 25
Alexandria
(Frequency) (%Change)
2 4
5 -3
10 -5
50 -2
100 0
Source: NOAA Atlas 14, Vol. 8, Ver. 1 Midwestern States
Draft: October, 2012
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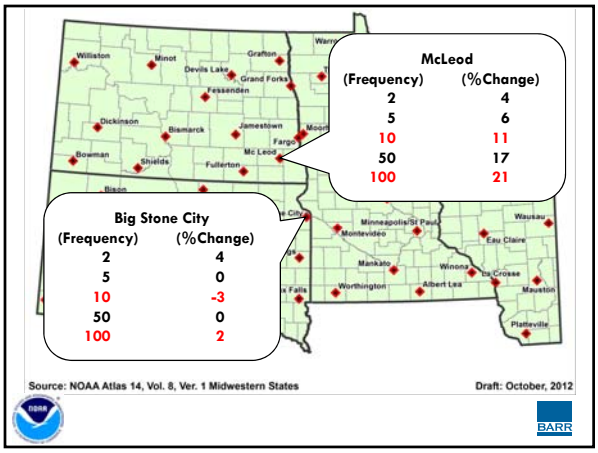
McLeod
(Frequency) (%Change)
2 4
5 6
10 11
50 17
100 21
Big Stone City
(Frequency) (%Change)
2 4
5 0
10 -3
50 0
100 2
Source: NOAA Atlas 14, Vol. 8, Ver. 1 Midwestern States
Draft: October, 2012
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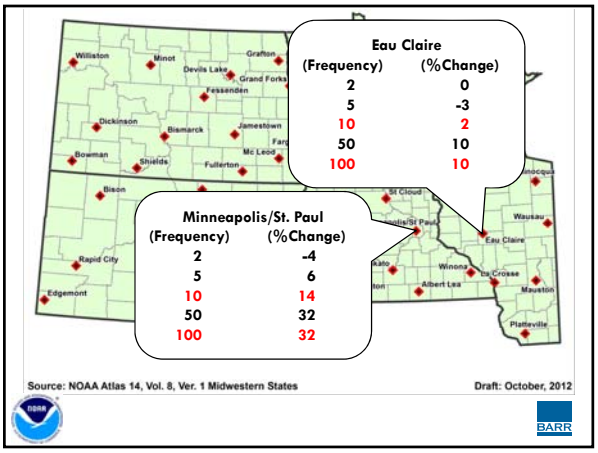
Eau Claire
(Frequency) (%Change)
2 0
5 -3
10 2
50 10
100 10
Minneapolis/St. Paul
(Frequency) (%Change)
2 -4
5 6
10 14
50 32
100 32
Source: NOAA Atlas 14, Vol. 8, Ver. 1 Midwestern States
Draft: October, 2012
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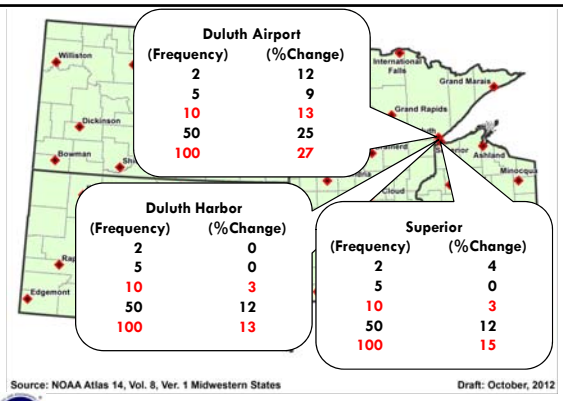


Atlas 14 technical review of results

- peer review comments submitted to NOAA:
  - questions about methodologies
  - observed anomalies
    - localized effects
    - degree of change over short distances

Atlas 14 technical review of results

- results of peer and NOAA reviews:
  - NOAA dropped 14 stations around Minneapolis/St. Paul and at least 13 more elsewhere
  - re-running statistics with stations removed
  - addressing localized effects to smooth the rainfall depth lines (isopluvial)
  - maybe excluding data where there was not at least 50 years of record
  - still planning to publish in March

implications for water planners, designers, and regulators

- who (city, watershed org, state?) will decide which rainfall amounts will be used?
- ordinances, policies, and standards
- legal implications of using or not using Atlas 14 results

implications for water planners, designers, and regulators

- newly placed systems may now appear to be undersized
- SCS Type II distributions will change since they are based on storm events

http://minnesota.publicradio.org/display/web/2010/06/25/severe-weather

implications for water planners, designers, and regulators

- flood protection: FEMA DFIRM mapping and levee certifications
- modeling – design storms

http://minnesota.publicradio.org/display/web/2010/06/25/severe-weather

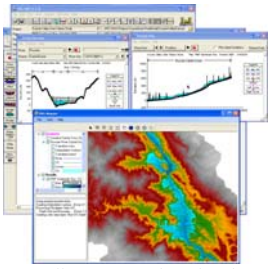
implications for water planners, designers, and regulators

- design
  - future storm sewer infrastructure sizing
  - future development possibly held to higher standards
  - integrating current and future infrastructure capacities
  - detention ponds
  - water quality treatment features

Barr Project: Valley Creek stream stabilization

possible approaches for water planners, designers, and regulators

- rainfall depths can now be reported as a range or confidence interval
  - allows a range of flood levels or flow rates to be calculated
  - can conduct model sensitivity analyses
- possibly switch to risk management approach



http://www.hec.usace.army.mil/software/hec-ras/

possible approaches for water planners, designers, and regulators

- base level of service on rainfall depth rather than event probability
- take advantage of opportunities to mitigate impacts:
  - safe overflow routes
  - increase storage and infiltration
  - larger easements
  - increase conveyance

so stay tuned…

very complex and broad-reaching issues to be addressed in the future

Thank You!